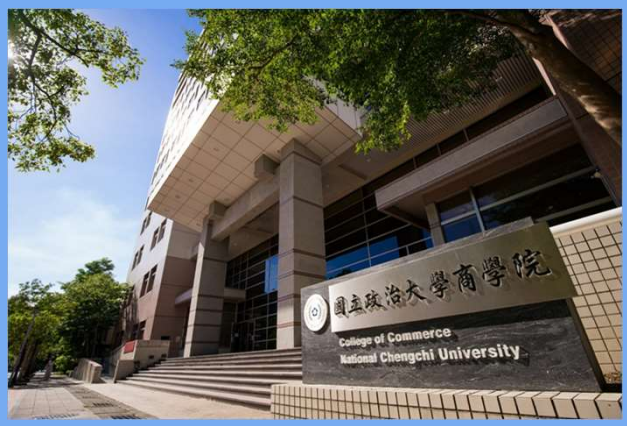
國立政治大學資訊管理學系
NCCU DEPARTMENT OF MANAGEMENT INFORMATION SYSTEMS

Introduction to Computer Science

Week 6- Network II



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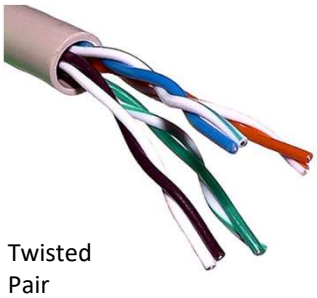
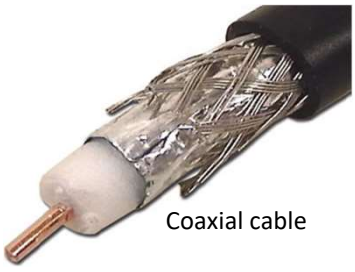
Directed Media



Twisted Pair



Coaxial cable

Optical fiber

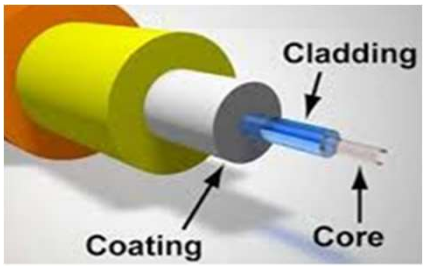
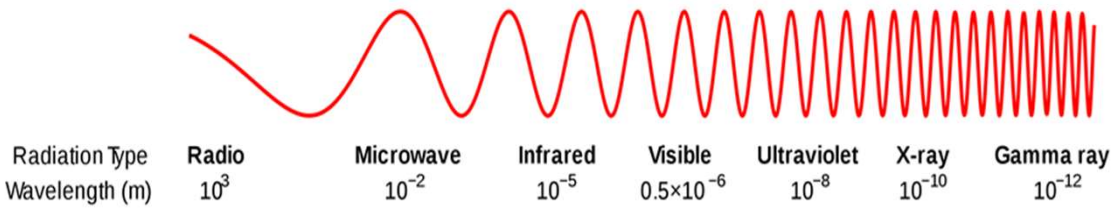


Image credit: https://www.youtube.com/watch?v=6NwmWP6EQxQ
Image credit: https://images.app.goo.gl/rvMfpx3gQVcMjfD96

Undirected Media: Electromagnetic Radiation



Wi-Fi: 2.4 GHz vs. 5 GHz

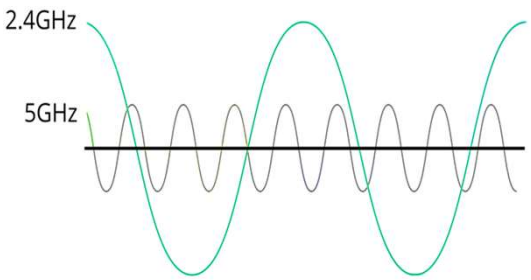


Image credit: https://www.hns-berks.co.uk/blogs/archives/04-2018/2
https://beambox.com/townsquare/what-s-the-difference-between-2-4ghz-and-5ghz-wifi

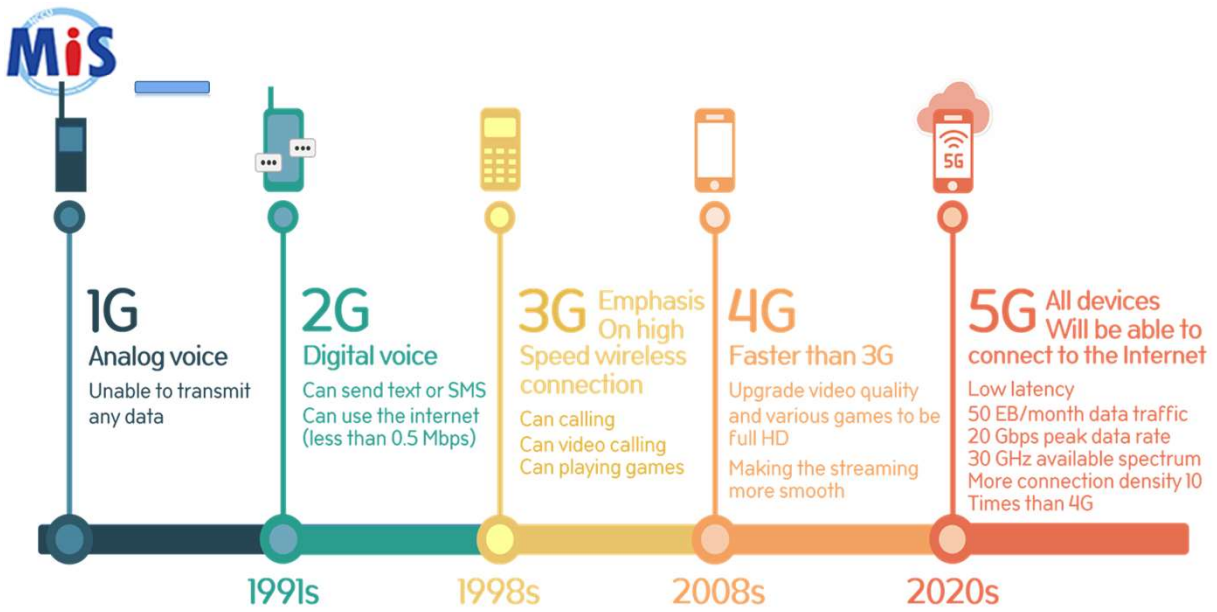


Image credit: https://5glearning.org/evolution-of-mobile-generation-from-1g-to-6g/

Internet Service Provider (ISP)

Connects the network to the Internet through an ISP

- ISP is a business that provides Internet access to individuals and organizations for free or for a fee
- ISP may also provide online services, such as e-mail, personal Web site or home page

Latency: the time it takes a signal to travel from one location to another on a network

Bandwidth: the amount of data and information that can be transmitted through the transmission medium

- The measure of the network's capability to send and receive data

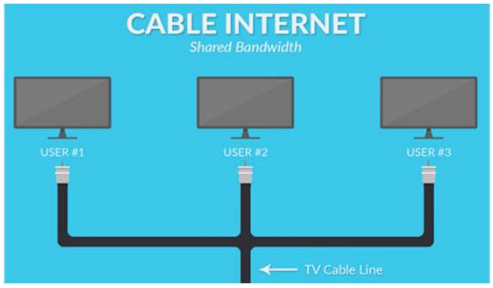
Physical layer - Communications Lines

Dedicated line is a type of always-on physical connection that is established between two communication devices

- Cable
- DSL
- T-Carrier
- Optical fiber

Cable	256 Kbps to 100 Mbps or higher
DSL	256 Kbps to 8.45 Mbps
T1	1.544 Mbps
T3	44.736 Mbps

Cable vs. DSL



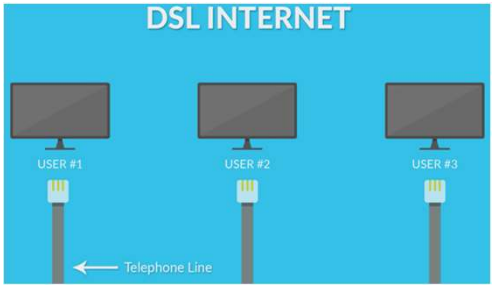


Image credit: https://www.youtube.com/watch?v=6NwmWP6EQxQ

Elements and Devices to Create a Network

Modem: the communications device that connects a communications channel to a device

Hub: a central point in a network; transmit data to all devices

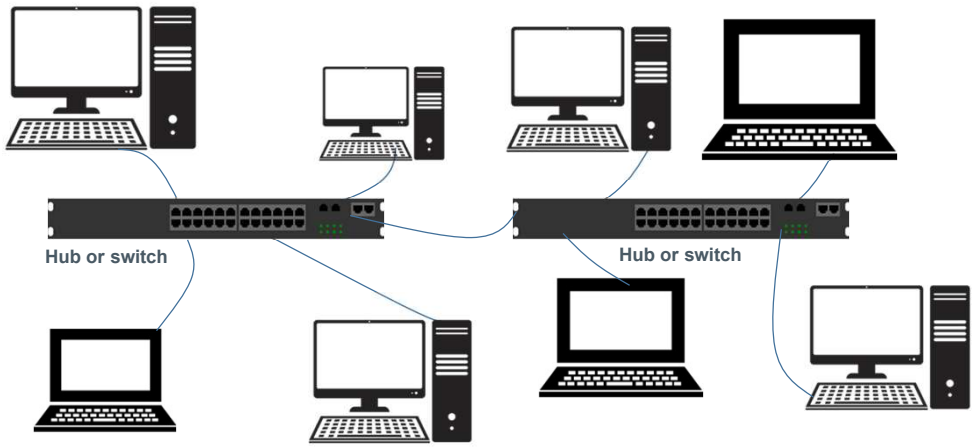
Switch: a central point in a network; only transmits data to the intended device(s)

Router: device that connects two or more **networks**

- Connect the computer to the Internet
- Wireless router: provide wireless network access to the devices

Hub vs. Switch

A hub or switch is a device which provides a central point for cables in a network



Router

A router connects multiple computers/devices or other routers together and transmits data to the destination on a network

- Through a router, the networks can share access to a broadband Internet connection, such as through a cable or DSL modem

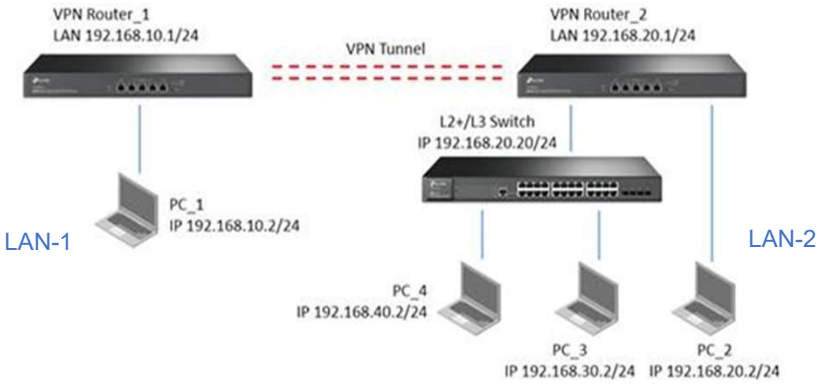
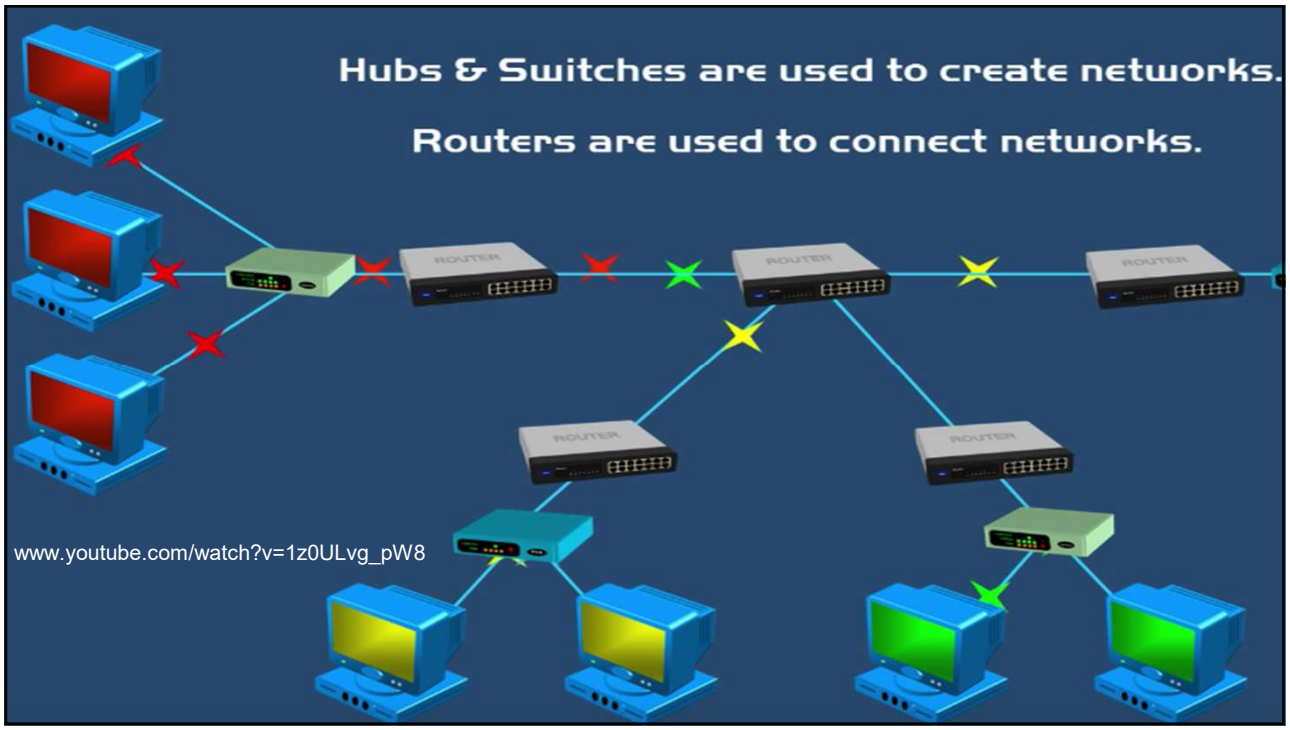


Image credit: https://www.tp-link.com/tw/support/faq/2136/



Network Interface Controller/Card (NIC)

NIC enables computers or devices that without built-in networking capability can access network

NIC may have a visible antenna to communicate with the wireless network

- Wireless network interface card (WNIC)

Image credit: https://en.wikipedia.org/wiki/Network_interface_controller

Image credit: https://networkustad.com/2019/11/17/wireless-network-interface-card-wnic/

Mac Address

Media Access Control (MAC) address identifies a unique network interface

MAC address is a 12-digit string

- Each digit can be any number (0~9) or a letter (b/t A and F)
  - **E1-A5-5E-24-34-EB**
- First six digits represent the adapter's manufacturer
- Last six digits represent the unique identification num for that specific adapter

The MAC address **contains no information about which network** a device is connected to

- Deny access to specific MAC addresses, can't do it with IP address

Mac Address & IP Address

IP address: where the target (like your home address)

- Assigned by ISPs and can be re-assigned as devices connect and disconnect
- Multiple devices (with virtual IPs) share a public IP
  - Many people live in the same place (same mail address)
- The IP address gets the data to your router

MAC address: who the target is (like your personal ID)

- Tied to a physical adapter and are assigned by manufacturers
- Every device on a router has a unique MAC address
  - Multiple personal IDs in your home
- MAC address identifies which device is which

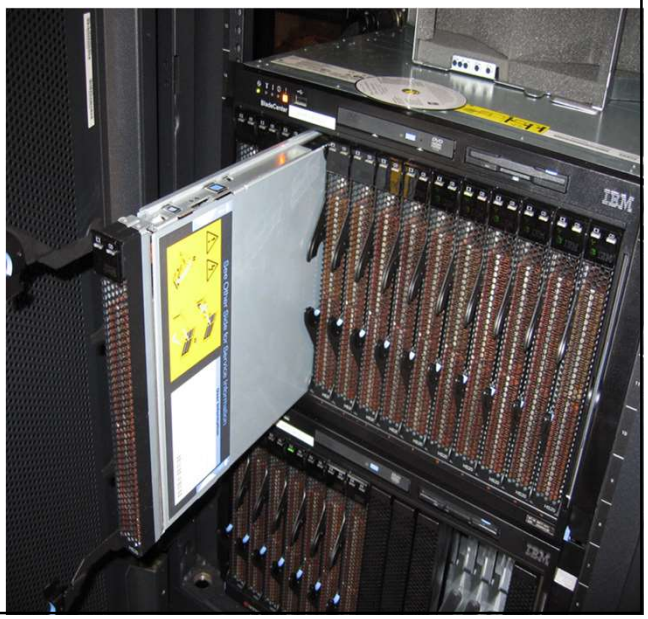
Servers

A **server** is a computer dedicated to providing services to other computers or devices on a network

- Tower server
  - Desktop or laptop can be
- Rack server
  - Require more spaces for the machines
  - Better scalability (more memory slots)
    - Might strengthen the computing power
- Blade server
  - Save space but cooling can be an issue
  - Limited spaces for scalability
  - Support hot plugging

Photo credit: https://www.youtube.com/watch?v=bhT1rV5JUQc&ab_channel=ITSimplifiedinHINDI

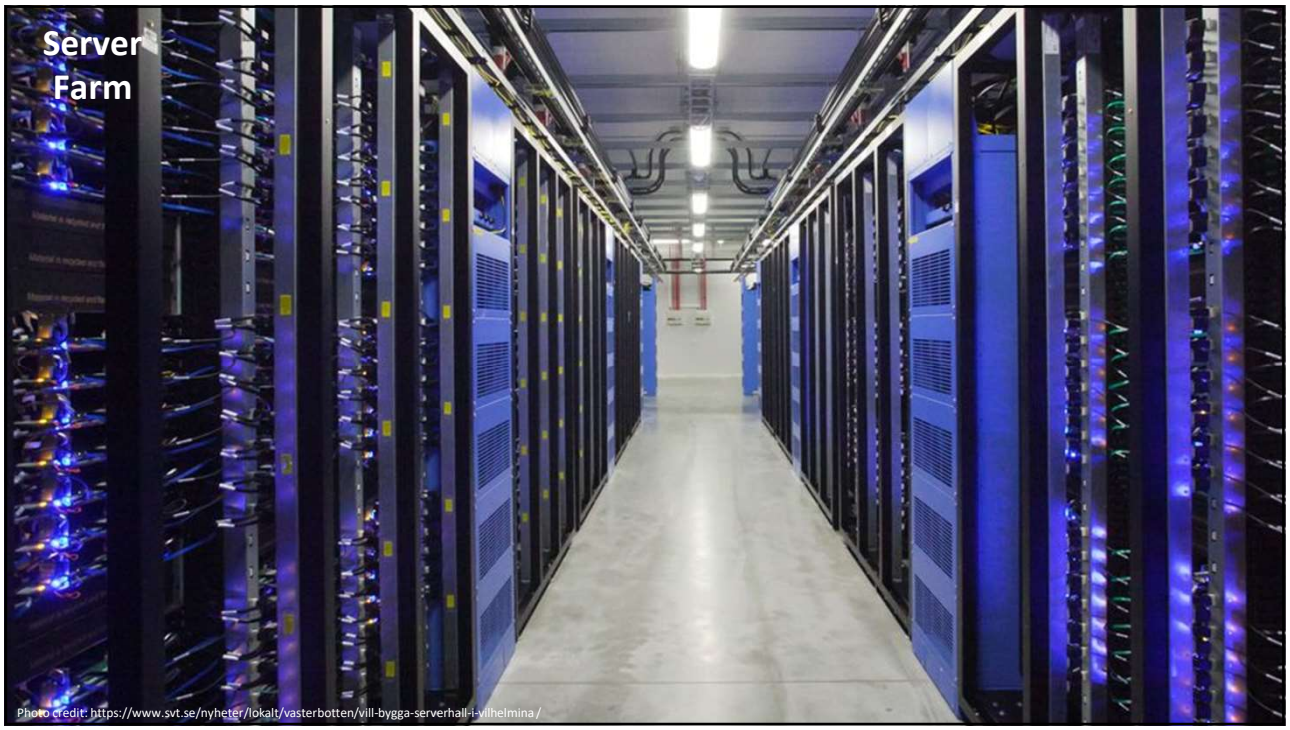
Rack server vs. Blade server



Mainframe

Mainframes are large, expensive, powerful server that can handle high-volume online transaction processing simultaneously

- Highly reliable, robust backward compatibility
- Finance and banking industries
- High learning curve for most administrators



Server Farm

A **server farm** is a network of multiple servers in a single location

- Increasingly being used instead of mainframes by large enterprises
- Server farms do not yet reach the same reliability levels as mainframes
- Num of computers in large server farms, the failure of an individual machine is common
- Better scalability, cost-effective, agile and innovative environments
- Easy to maintain the machines (with universal OS, such as Linux and Windows)

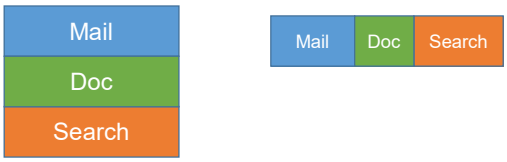
Dedicated Servers perform a specific service

Type	Main Service Provided
Application server	Stores and runs apps
Backup server	Backs up and restores files, folders, and media
Database server	Stores and provides access to a database
Domain name server	Stores domain names and their corresponding IP addresses
File server	Stores and manages files
FTP server	Provides a central location for online gaming
Mail server	Stores and delivers email message
Print serer	Managers printers and documents being printed
Web server	Stores and delivers requested webpages to a computer via a browser

Virtual Servers

Virtualization is the practice of sharing or pooling computing resources, such as servers and storage devices

- Server virtualization uses software to enable a physical server to emulate the hardware and computing capabilities of one or more servers, known as virtual servers

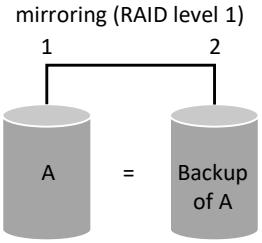


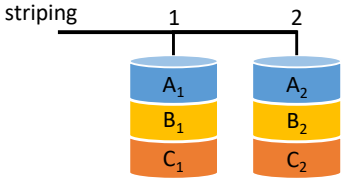
https://www.youtube.com/watch?v=V9AiN7oJaIM

Enterprise Storage - RAID

- Enterprise hardware allows large organizations to manage and store data and information with equipment designed for heavy use, maximum efficiency, and maximum availability
- RAID (redundant array of independent disks) is a group of two or more integrated hard drives
  - RAID duplicates data, instruction, and info to improve data reliability
  - RAID 0, 1, 5, and 10

www.youtube.com/watch?v=U-OCdTeZLac





Backup

Backup is a copy of a file, program, or media. If the original file is lost, damaged or destroyed, you can use the backup

- To **back up** a file means to make a copy of it

Off-site backups are stored in a different location from the computer or mobile device site

Types of Backups

Differential backup: the files changed since last full backup
(Sun←→Mon, Sun←→Tue)

Incremental backup: backup the files changed since last incremental backup
(Sun←→Mon, Mon←→Tue)

Type	Description
Full backup	A full backup is the process of making at least one additional copy of **all data files** that an organization wishes to protect in a single backup operation. The files that are duplicated during the full backup process are designated beforehand by a backup administrator or other data protection specialist.
Differential backup	A differential backup is a cumulative backup **of all changes made since the last full backup**, i.e., the differences since the last full backup. The advantage to this is the quicker recovery time, requiring only a full backup and the last differential backup to restore the entire data repository.
Incremental backup	An incremental backup is a backup type that only copies data that **has been changed or created since the previous backup activity** was conducted. An incremental backup approach is used when the amount of data that has to be protected is too voluminous to do a full backup of that data every day.
Selective backup	Selective backup is a type of data backup process in which only **user-specified data**, files and folders are backed up. It enables short listing only selected files in a backup process rather than backing up the whole folder, disk or system. Selective backup is also known as partial backup.